



Evaluation of Malondialdehyde (MDA) and Lipid Profile in Iraqi Pregnancy Women with Hypertension in Thi-Qar Governorate

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Abstract:

Objectives: Pregnant women with hypertension were studied to determine if their lipid profiles changed. It is well known that altered lipid profiles are associated with essential hypertension. This is because oxidative stress and weakened antioxidant defense can lead to free radical-induced membrane lipid peroxidation and potentially damage the vascular endothelium.

Methods: For this research, we had one hundred expecting mothers split into two groups—one of 50 mums-to-be dealing with hypertension and the other serving as a control set. All of our participants spent 8 to 10 hours fasting prior to us collecting a blood sample from them. We then took note of their triglyceride levels, cholesterol readings, HDL, LDL, and the amount of MDA in their system.

Results: Some telling differences arose when comparing a control group to the patient group. The patient cohort had higher TCH, TG, and VLDL than their counterparts. That said, LDL levels were the same for both groups. At the same time, HDL levels were lower in the patient set. whereas, MDA levels remained indistinguishable between the two groups.

Conclusion: It's been expected that mamas with hypertension are more likely to see their lipid peroxidation levels rise and be confronted with cardiovascular disease later in life. The evidence? High TC, LDL, TG, VLDL, and MDA concentrations are present in the bloodstream.

Key words: Lipid profile, pregnancy, MDA, hypertension.

INTRODUCTION

It's common for mums-to-be to experience pregnancy-induced hypertension (PIH) during gestations (1). Symptoms of this condition include high blood pressure, protein in the urine, and an expansion in volume caused by disease (2). According to the American Society of Hypertension, gestational hypertension can be classified into various types (3).

Pregnancy can bring with it a host of blood pressure-related woes, including preeclampsia, chronic high BP, and atypical hypertension. Thankfully, these issues are being taken seriously—PIH is one of the three most common killers of women, fetuses, and newborns. It's clear why this diagnosis carries so much importance (4). The World Health Organization warns pregnant women with dangerously high blood pressure because it can pose a real risk to both mama and baby. In terms of—transfusion through the placental wall, to stunted growth, early labor, or even infant mortality (5,6). Even though there are numerous contributing factors to PIH (Pregnancy-Induced Hypertension), we still don't know why it happens and how to prevent it. Two significant culprits may be an aberrant intertwining of the uterine artery and an immune system mismatch between mother, placenta, and fetus during implantation (7).

When the placenta's blood flow slows, the body's immune defenses weaken and an array of ischemia-induced chemicals crop up. This also leads to vascular endothelial dysfunction, characterized by upped concentrations of constrictors—like endothelin-1 and thromboxane—and reduced dilators such as nitric oxide and prostacyclin. Furthermore, elements such as lipid deficiencies, oxidative stress, and insulin resistance increase the risk of preeclampsia due to their negative effects on endothelial cells. Insulin resistance puts the brakes on lipoprotein lipase, a key element in breaking down triglycerides. So, those with PIH (particularly women) are far more likely to wind up with CVD, HTN, and diabetes (8).

The lipid profile is a blood test that uncovers the amount of fat in your circulatory system. And it looks at five types of lipids: cholesterol, triglycerides, HDLs, LDLs, and VLDLs (9). These fluctuate with age, gender, genetics, and lifestyle habits such as exercise, nutrition, smoking status, and diabetes treatment. Lipid metabolism disorder can be an aftereffect of gestational hypertension (10).

In fact, during pregnancy, the changes that occur are not limited to the uterus only, but also in the chemistry of its mother's body changes rapidly during those nine months—especially in her liver and fat stores. From weeks one to eight, there's a dip and then a surge of triglycerides, fatty acids, and phospholipids. Estrogen is mainly responsible for a rise in triglyceride. Where an increase in the level of estrogen during pregnancy. Plus, insulin levels play their part too (11).

When a pregnant woman has hypertension, her blood has a rise in concentrations of free fatty acids, triglycerides, LDL, HDL, total lipids, and VLDL. Plus, her plasma levels of these lipids are buttressed by lipid peroxidase and cytokines. In addition to causing hypertension in the mother-to-be, these sky-high triglycerides often get deposited in delicate uterine arteries. It's also worth noting that this phenomenon can result in an uptick of small and dense LDL which can lead to deadly endothelial failure (11).

Gestation sometimes causes a lot of trouble in terms of triglyceride-rich lipoproteins. Low breakdown and high production are the main offenders causing a rise in triglycerides. With those two factors present, the liver has no other option but to discharge free fatty acids into VLDL, after lipolysis in adipocytes increases, leading to an even more significant influx of free fatty acids for the liver. Owing to this, triglyceride-rich proteins flood out (12). The liver's production of fatty acids could be caused by insulin resistance too, since lipogenesis doesn't back away from it. In the last stage of gestation, high estrogen levels mean VLDL becomes more common, and more fat gets formed in the liver. This then reduces glucose synthesis.

Mice with increased insulin levels have an uptick in hepatic fatty acid production, as a mouse study shows (13). Lipoprotein lipase and hepatic lipase concentrations drop off, causing a sluggishness when it comes to getting rid of triglyceride-packed lipoproteins (14). It's probably because of heightened estrogen levels that hepatic lipase decreases (15). Conjecture has it that this is due to insulin resistance and upswings in estrogen. When circulating ester transfer protein activity rises, triglycerides pass from VLDL to both LDL and HDL. When we detected a rise in CETP activity (14), we noticed that it created a decrease in hepatic lipase. This thereby impeded the removal of triglycerides from particles of lipoprotein. In essence, this meant more TGs were trapped in LDL and HDL particles.

With pregnant women with high blood pressure, we wanted to see how much of an effect the lipid profile had. So, we dove deeper and studied the MDA oxidation levels in relation to high blood pressure. It impacted the lipid profile, making our findings more than relevant.

PATIENTS AND METHOD

Between July 2020 and June 2021, two teams of scientists conducted a study at Bint Al-Huda Hospital in Thi-Qar, Iraq, and the Biochemistry Laboratory of the University of Thi-Qar. All the participating women gave verbal consent to participate. In total, there were 100 female participants with hypertension during pregnancy and an additional group of healthy pregnant women between 20 and 35 years old.

Table I outlines the specifics of the two groups' ages and numbers examined. All in all, hundred people participated in this study – fifty pregnant women with hypertension plus fifty healthy expectant mothers. Prior to taking part, these high blood pressure moms had been identified by medical team agreement.

Table1. Information about the number and age of the group examined

Groups	No	Rang of Age (year)
Patients(pregnant women with hypertension)	50	20-35
Control (healthy pregnant women)	50	20-35
Total	100	20-35

Taking a blood sample

Approximately 5mL of blood samples were obtained by inserting sterile disposable syringes into clear plastic tubes and puncturing a vein. To ensure clotting, the serum was immediately separated and placed in simple tubes. It was then stored at -20°C until use or immediate analysis after being centrifuged at 3000 rpm for 10 minutes.

Determination of serum malondialdehyde (MDA)

The serum aldehyde content was determined using the (16) method of spectrophotometry. To the 150 ml of serum, the following was added: 1ml of BDH's 17.5% trichloroacetic acid TCA and 1ml of 0.66% trichloroacetic acid TBA were incorporated by vortexing. They were then floated in warm water for 15 minutes and allowed to cool. Overall, these steps were taken. After being left to sit at room temperature for 20 minutes, the mixture with 70% TCA was supplemented with one milliliter. Then, the sample was centrifuged at 2000 RPM for 15 minutes, the supernatant was then removed for analysis by spectrophotometry at (532nm). The amount of MDA in the concentrate was determined by this method:

$$MDA \left(\frac{\mu\text{mol}}{L} \right) = \frac{\text{absorbance at 532}}{L \times \epsilon} \times D \times 10^6$$

L: light path (1cm)

ϵ : Extinction coefficient $1.56 \times 10^5 \text{ M}^{-1} \cdot \text{cm}^{-1} = 6.7$

D: Dilution factor = 1 ml Vol. Used in ref./0.15

Determination of Serum Lipid profile

The method used to measure serum total cholesterol was based on Allan and Dawson's technique from 1979(17). The reagents supplied by Biolabo (France) were utilized for this purpose. For analyzing serum TG, the approach described by Tietzel et al., 1999 was followed (18). The reagents provided by Biolabo (France) were used for this measurement as well. Serum HDL was examined using the method specified by Lopes-Virella, 1977 (19), and once again, the reagents supplied by Biolabo (France) were employed. The concentrations of LDL and VLDL were determined as per Friedwald et al., 1972 (20).

LDL (mg/dl) = Total cholesterol – (HDL + VLDL)

VLDL (mg/dl) = serum TG /5

Statistical Analysis

All statistical evaluations were conducted with Microsoft Excel 2010 and a version of Windows that is 23.0. To demonstrate the results, the average, standard deviation, and LSD were employed. The dissimilarity of the parameters between the different groups of the study was assessed through a one-way analysis of variance (ANOVA). For a significant result, p-values that were smaller than 0.05 were considered significant.

Results and Discussion

Table 1. Demographics of the study population.

Characteristics	Group I n=50	Group II (Controls) n=50	P
Age (years)	28.52±5.40	27.48±5.65	0.788
Gravidity	2.80±1.15	3.76±1.08	0.057
Parity	2.28±0.98	3.24±1.42	0.059
POG (weeks)	30.16±5.33	28.60±4.34	0.788
Systolic BP (mmHg)	152.56±5.3	119.92±1.23	0.000
Diastolic BP (mmHg)	102.84±7.64	77.44±7.41	0.000
Family history of high BP No/yes – n (%)	46(92)/4(8)	47(94)/3(6)	

Participating in the study were 100 individuals, half of which were patients and half were controls. Their ages spanned from 18 to 40 years. The average age of the patient population was 28.52 years, with a standard deviation of 5.40, while the control population had an average age of 27.48 years, with a standard deviation of 5.65. It is important to note that the majority of both the patient group (84.5%)

and the control group (89.2%) were between the ages of 20 and 35. Also, the patient group had a distribution of 30.16 weeks, with a standard deviation of 5.33, while the control group had an average of 28.60 weeks, with a standard deviation of 4.34. In terms of blood pressure, the patient collective had a systolic blood pressure (SBP) of 152.56 mmHg and a diastolic blood pressure (DBP) of 102.84 mmHg. Conversely, the control group had a SBP of 119.92 mmHg and a DBP of 77.44 mmHg. Compared to the control group, the patient group had a lower percentage of pregnant women and a lower number of parity and gravidity-related traits in terms of obstetric attributes. Our research showed that a family history of high blood pressure was present in only 8% of the patient population and 6% of the control population. Notably, a statistical difference was observed in the cases as presented in Table 1's data distribution.

Table 2: MDA lipid profile values for the two study groups.

	Sample	N	Mean	Std. Deviation	p.v
TC	Pa.	50	254.48	36.26	0.016
	Co.	50	177.95	18.00	
TG	Pa.	50	343.40	60.96	0.000
	Co.	50	147.44	10.03	
HDL	Pa.	50	47.50	4.83	0.080
	Co.	50	55.66	10.09	
VLDL	Pa.	50	54.66	13.22	0.002
	Co.	50	27.24	6.29	
LDL	Pa.	50	136.49	19.27	0.191
	Co.	50	113.29	20.65	
MDA	Pa.	50	4.24	.66	0.569
	Co.	50	2.23	.54	

Table 2 shows that the patient group had a higher percentage of TCH, TG, and VLDL than the control group. Interestingly, the LDL level was measured in a similar manner for both groups. Interestingly, the patient group had a lower HDL concentration in comparison to the control group. Regarding the MDA levels, no significant difference between the patient and control groups was observed.

DISCUSSION

During the typical course of a pregnancy, there is a significant increase in complex lipids and FFAs. The concentrations of TGs increase by three times, while the levels of VLDL-C have a 50% increase. Also, the levels of HDL increase(21,22). Interestingly, this elevated triglyceride level in normal pregnancy is not considered a pathological threat, as the pattern of increase is different from the atherogenic triglycerides associated with hypertension in pregnancy, which is quite atherogenic. It's important to note that TG is typically stored in pre-conditioned vessels like the uterine artery, this can lead to endothelial failure (11).

In pregnant women with high blood pressure, the levels of lipid profile and MDA would be noted to be different than in women with healthy pregnancies (54).

In women diagnosed with gestational hypertension, there were significant increases in the serum levels of TC, TG, LDL, and MDA. Conversely, there was a significant reduction in the levels of HDL. These findings concur with the recognized significant causes of high blood pressure during pregnancy. (23)

Hormones typically control the lipids metabolism during the pregnancy process (24). The hormones estrogen and insulin have an effect on this metabolic process. When a pregnant woman suffers from

high blood pressure, the levels of estrogen decrease and insulin resistance increase, resulting in a significant increase in blood lipids that may lead to atherogenic dyslipidemia (25).

Compared to the typical pregnant woman, those with high blood pressure had a significantly increased TC level. This score is in agreement with the study done by some researchers (26–28).

As documented in a research study by Adiga Usha et al, hypercholesterolemia causes an increase in lipid peroxidation and a decrease in antioxidant capacity, this results in an unstable ratio of peroxides and antioxidants that ultimately leads to stress. Contrasting with our results, Rubina Aziz (29), Punthumapol C (30), and Islam NAF (31) state that typical gestation exhibits an increase in TC.

Women with PIH had a significantly higher average triglyceride level than women with NTP, which concurs with previous research (32,33). The elevation of serum triglycerides can be attributed to a decrease in the activity of hepatic lipase involved in the synthesis of triglycerides, as well as a decrease in the activity of lipoprotein lipase that is involved in the storage of triglycerides in adipose tissue (27). This can cause endothelial damage in the uterine vessels or indirectly via the production of small, dense LDL, or may be associated with increased coagulation (32).

The average LDL value was higher in women with PIH than in healthy pregnant women, this concurs with previous studies (32, 28, 34). LDL is primarily produced in the liver and is paramount in delivering cholesterol to other tissues. LDL particles have a greater propensity to enter tissues, which makes them more atherogenic (35). The decreased ratio of prostacyclin to thromboxane A-2 and the reduction of other vasoactive endothelial cell molecules is attributed to oxidative stress and oxidation. This causes the upregulation of pro-inflammatory cytokines and endothelial cell adhesion molecules in the intracellular space. Additionally, the generation of foam cells in the interior of an endothelial cell is associated with the process of LDL oxidation. As such, endothelial cell failure occurs, resulting in HTN. (36)

No significant difference was observed in the levels of VLDL between the severe patients and controls ($P>0.05$). The quantity of lipids, including VLDL, augmented during PIH results from the liver's inability to oxidize beta-peptides properly. As such, the liver acquires LDL, triglycerides, and VLDL. The levels of Plasma Lipoprotein increase, which causes an increase in Lipoprotein peroxidase and cytokines. This causes endothelial cells to be disrupted, this leads to body-wide vasoconstriction (8,9).

Interestingly, the mean value of HDL was lower in women with PIH than in women without PIH. This score concurs with previous investigations by Singh and his colleagues (32,37). A significant cause of the lower serum HDL levels is the adverse effect of atherogenic lipoprotein (LDL) and the burden of inflammation. The essential function of HDL is to defend endothelial cells by collecting cholesterol from macrophages (38). Specifically, decreasing the amount of HDL in women with PIH decreases the stimulation of nitric oxide (NO), which results in the dysfunction of placental endothelial cells. Pre-eclampsia and eclampsia may adversely affect the endothelial cells, which is common(22).

The byproduct of metabolic processes, MDA, is of paramount importance in this context, as it is derived from lipids that have been involved in oxygen-related reactions of lipoperoxidation. Humans primarily rely on MDA for the proper functioning of their metabolism and overall health (39,40,41,42,43). Abnormal metabolism of MDA, along with decreased levels of antioxidants, can lead to increased oxidative stress, potential damage from free radicals, and various diseases associated with the abnormal response to free radicals (39,41,42,43). These conditions may also lead to metabolic issues and the intensification of a series of free radical reactions.

The increased xanthine/xanthine oxidase system the resulting xanthine oxidase activity which is one of the biochemical processes causes a rise in the severity of responses and promotes the oxidative destruction of substances. This also leads to the peroxidation of various lipids in the blood, including

polyunsaturated fatty acids, unsaturated phospholipids, glycolipids, and cholesterol. This procedure ultimately produces and releases a significant amount of free radicals (FRs) and oxygen species (44-41,43).

The abnormal changes such as oxidative stress and increasing of FRs chain reactions that occur during gestation harm the smooth muscle cells in the arteries, a lack of cell function that lines the blood vessels, and an increase in vessel resistance (45,46,47). These alterations also have an effect on the membrane properties and elasticity of cells in the circulation system, including red blood cells, endothelial cells, and smooth muscle cells. This decrease in membrane flexibility can cause increased blood flow variability (13,49,50). As such, women who have pregnancy-induced hypertension are prone to have high SBP and DBP too.

CONCLUSION

The results of this study suggest that an anomalous metabolism of lipids, specifically increased levels of TCH, TG, LDL, and Peroxidized Lipids, may contribute to the observed stress and functional issues in PIH. As a result, monitoring the levels of blood lipids and the amount of lipid peroxidase during pre-natal care could help to identify and prevent obstetric issues like PIH. Also, this research suggests that women with gestational hypertension have increased oxidative stress and potential for damage caused by free radicals.

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Conflict of Interest

No conflict of interest identified

Consent to Participate

All participants obtained written information before participating in the study.

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